CLAIMS

What is claimed is:

1. A method for reducing the amount of colored by-products in L-ascorbic acid synthesized from 2-keto-L-gulonic acid or derivatives of 2-keto-L-gulonic acid comprising adding a sulfite species to a synthesis reaction comprising conversion of a starting material comprising 2-keto-L-gulonic acid or a derivative of 2-keto-L-gulonic acid to L-ascorbic acid and allowing the sulfite species to interact or react with colored by-products in the synthesis.

2. The method of claim 1, wherein the sulfite species is added to the synthesis prior to conversion of the 2-keto-L-gulonic acid compound to L-ascorbic acid.

3. The method of claim 1, wherein the sulfite species is added to the synthesis after conversion of at least part of the 2-keto-L-gulonic acid compound to L-ascorbic acid product.

4. The method of claim 1, further comprising separating an L-ascorbic acid product from the synthesis reaction.

5. The method of claim 1, wherein the sulfite species comprises SO_2, HSO_3^-, $S_2O_3^{2-}$, SO_3^{2-}, $S_2O_4^{2-}$, and $S_2O_5^{2-}$.

6. The method of claim 5, wherein the sulfite species comprises sulfurous acid.

7. The method of claim 1, wherein the sulfite species also acts as a catalyst for the conversion of the 2-keto-L-gulonic acid or derivative of 2-keto-L-gulonic acid to L-ascorbic acid.

8. The method of claim 1, wherein the sulfite is added to a final concentration comprising a range of 0.5% to 50% by moles relative to the 2-keto-L-gulonic acid compound.

9. The method of claim 1, wherein the sulfite is added to a final concentration comprising a range of 1% to 20% by moles relative to the 2-keto-L-gulonic acid compound.

10. The method of claim 1, wherein the 2-keto-L-gulonic acid comprises an aqueous stream from a fermentation process for producing 2-keto-L-gulonic acid.

11. The method of claim 1, wherein the 2-keto-L-gulonic acid comprises hydrolysis of the bisacetonide of 2-keto-L-gulonic acid or the esters of 2-keto-L-gulonic acid.

12. The method of claim 1, wherein the synthesis comprises an aqueous solution of 1 to 40 weight percent 2-keto-L-gulonic acid.

13. The method of claim 1, wherein the synthesis comprises an aqueous solution of 5 to 30 weight percent 2-keto-L-gulonic acid.

14. The method of claim 1, wherein the synthesis comprises an aqueous solution of 8 to 15 weight percent 2-keto-L-gulonic acid.

15. The method of claim 1, wherein the conversion of 2-keto-L-gulonic acid substrate to L-ascorbic acid product ranges from 5 to 95%.

16. The method of claim 1, wherein the conversion of 2-keto-L-gulonic acid substrate to L-ascorbic acid product ranges from 20 to 75%.

17. The method of claim 1, wherein the conversion of 2-keto-L-gulonic acid substrate to L-ascorbic acid product ranges from 30 to 60%.

18. An ascorbic acid product comprising reduced coloration made by the method of claim 1.

19. A continuous process for manufacturing L-ascorbic acid comprising the steps of:

(a) heating an aqueous solution of starting material comprising 2-keto-L-gulonic acid or a derivative of 2-keto-L-gulonic acid in a reactor in the presence of at least one sulfite species under conditions such that L-ascorbic acid is generated;

(b) continuously removing from the reactor a post-reaction solution comprising unreacted 2-keto-L-gulonic acid starting compound and L-ascorbic acid;

(c) removing at least a portion of sulfur containing compounds from the post-reaction solution;

(d) removing at least a portion of the L-ascorbic acid from the post reaction solution; and

(e) recycling unreacted 2-keto-L-gulonic acid compound back to the reactor.

20. The method of claim 19, wherein the sulfite species comprises SO_2, HSO_3^-, $S_2O_3^{2-}$, SO_3^{2-}, $S_2O_4^{2-}$, and $S_2O_5^{2-}$.

21. The method of claim 20, wherein the sulfite species comprises sulfurous acid.

22. The method of claim 19, wherein the sulfite species comprises a catalyst for the conversion of 2-keto-L-gulonic acid to L-ascorbic acid.

23. The method of claim 19, wherein the sulfite is added to a final concentration comprising a range of 0.5% to 50% by moles relative to the 2-keto-L-gulonic acid compound.

24. The method of claim 19, wherein the sulfite is added to a final concentration comprising a range of 1% to 20% by moles relative to the 2-keto-L-gulonic acid compound.

25. The method of claim 19, wherein the 2-keto-L-gulonic acid comprises an aqueous solution from a fermentation process for producing 2-keto-L-gulonic acid.

26. The method of claim 19, wherein the 2-keto-L-gulonic acid comprises an aqueous solution of 2-keto-L-gulonic acid derived from the hydrolysis of the bisacetonide of 2-keto-L-gulonic acid or the esters of 2-keto-L-gulonic acid.

27. The method of claim 19, wherein the synthesis of L-ascorbic acid from 2-keto-L-gulonic acid comprises an aqueous solution of 1 to 40 weight percent 2-keto-L-gulonic acid.

28. The method of claim 19, wherein the synthesis comprises an aqueous solution of 5 to 30 weight percent 2-keto-L-gulonic acid.

29. The method of claim 19, wherein the synthesis comprises an aqueous solution of 8 to 15 weight percent 2-keto-L-gulonic acid.

30. The method of claim 19, wherein the conversion of 2-keto-L-gulonic acid substrate to L-ascorbic acid product preferably ranges from 5 to 95%.

31. The method of claim 19, wherein the conversion of 2-keto-L-gulonic acid substrate to L-ascorbic acid product ranges from 20 to 75%.

32. The method of claim 19, wherein the conversion of 2-keto-L-gulonic acid substrate to L-ascorbic acid product ranges from 30 to 60%.

33. The method of claim 19, wherein the sulfur containing compounds of step (c) comprise residual sulfite and/or sulfite bound by-products.

34. The method of claim 19, wherein the sulfur containing compounds of step (c) comprise sulfate.

35. The method of claim 19, wherein step (c) comprises removing sulfur containing compounds by adsorption with a solid matrix.

36. The method of claim 35, further comprising activated carbon as the adsorption matrix.

37. The method of claim 35, further comprising ion exchange resin as the adsorption matrix.

38. The method of claim 19, wherein step (d) comprises continuously separating L-ascorbic acid from unreacted 2-keto-L-gulonic acid in the post reaction solution to form an L-ascorbic acid rich solution and a solution rich in 2-keto-L-gulonic acid compound.

39. The method of claim 38, further comprising the step of separating the L-ascorbic acid from the L-ascorbic acid rich solution by crystallization.

40. The method of claim 38, wherein on a 2-keto-L-gulonic acid and ascorbic acid only basis, the ascorbic-acid solution of step (d) is comprised of at least 75 weight percent of L-ascorbic acid.

41. The method of claim 38, wherein on a 2-keto-L-gulonic acid and ascorbic acid only basis, the ascorbic-acid solution of step (d) is comprised of at least 85 weight percent of L-ascorbic acid.

42. The method of claim 38, wherein on a 2-keto-L-gulonic acid and ascorbic acid only basis, the ascorbic-acid solution of step (d) is comprised of at least 90 weight percent of L-ascorbic acid .

43. The method of claim 38, wherein on a 2-keto-L-gulonic acid and ascorbic acid only basis, the 2-keto-L-gulonic rich solution of step (d) is comprised of at least 75 weight percent of 2-keto-L-gulonic acid.

44. The method of claim 38, wherein on a 2-keto-L-gulonic acid and ascorbic acid only basis, the 2-keto-L-gulonic rich solution of step (d) is comprised of at least 85 weight percent of 2-keto-L-gulonic acid.

45. The method of claim 38, wherein on a 2-keto-L-gulonic acid and ascorbic acid only basis, the 2-keto-L-gulonic rich solution of step (d) is comprised of at least 90 weight percent of 2-keto-L-gulonic acid .

46. The method of claim 19, wherein steps (a) through (e) comprise at least a 50 mole percent yield of L-ascorbic acid.

47. The method of claim 19, wherein steps (a) through (e) comprise at least a 60 mole percent yield of L-ascorbic acid.

48. The method of claim 19, wherein the weight ratio of 2-keto-L-gulonic acid to L-ascorbic acid is from 0.1 to 10 in the post reaction solution.

49. The method of claim 19, wherein the weight ratio of 2-keto-L-gulonic acid to L-ascorbic acid is from 0.2 to 5 in the post reaction solution.

50. The method of claim 19, wherein the weight ratio of 2-keto-L-gulonic acid to L-ascorbic acid is from 1 to 3 in the post reaction solution.

51. The method of claim 19, wherein step (d) comprises separation of L-ascorbic acid from unreacted 2-keto-L-gulonic acid in the post reaction solution by crystallization, chromatography, or electrodialysis.

52. The method of claim 51, further comprising ion exclusion chromatography for separation of L-ascorbic acid from unreacted 2-keto-L-gulonic acid in the post reaction solution.

53. The method of claim 51, further comprising simulated moving bed (SMB) chromatography for separation of L-ascorbic acid from unreacted 2-keto-L-gulonic acid in the post reaction solution.

54. The method of claim 19, wherein steps (c) and (d) comprise simultaneous separation and removal of sulfur containing compounds including residual sulfite with the separation and segregation of L-ascorbic acid and unreacted 2-keto-L-gulonic acid.

55. The method of claim 54, further comprising ion exclusion chromatography.

56. The method of claim 54, further comprising five-zone simulated moving bed (SMB) chromatography.

57. An ascorbic acid product comprising reduced coloration made by the method of claim 19.